

REMARKS

This application has been reviewed in light of the Office Action dated May 25, 2011. Claims 1 to 10 are presented for examination, of which Claims 1, 7, and 10 are in independent form. Claims 1 and 7 have been amended and Claim 8 has been cancelled. The substance of Claim 8 has been incorporated into Claim 1. These actions are taken without prejudice or disclaimer of subject matter. Also, new Claim 10 has been added. Favorable reconsideration and further prosecution are requested.

Claims 1, 3, 4, and 8 were rejected under 35 U.S.C. § 103(a), as being obvious over U.S. Pat. 6,395,564 (Huang) in view of U.S. Patent 6,417,019 (Mueller et al.); Claim 2 was rejected over Huang, Mueller, and WO 2000/12226 (Jones et al.); Claim 5 was rejected over Huang, Mueller, and U.S. Patent Application Publication 2003/0181122 (Collins, III, et al.); Claim 6 was rejected over Huang, Mueller, and U.S. Patent 6,483,196 (Wojnarowski et al.); Claim 7 was rejected over U.S. Patent Application Publication 2002/0003233 (Mueller-Mach et al.) in view of Huang; and Claim 9 was rejected over Huang, Mueller, and Mueller-Mach. For at least the reasons set out below, Claims 1 to 10 are believed to be allowable over the applied art.

Applicants thank Examiner Robert Huber and Supervisor Thao Le for the courtesies and thoughtful treatment accorded Applicant's representative, Christian Mannino, during the September 6, 2011 telephone interview. During the interview, Applicant's representative discussed proposed amendments to the independent claims. The Examiner and his Supervisor tentatively agreed that the proposed amendments to the claims would overcome the rejections over Huang, Mueller, and Mueller-Mach, but indicated that the claims as amended would require further search and consideration.

Applicant has incorporated the discussed changes to the claims in this Amendment. It is believed that this response, in conjunction with the Interview Summary issued by the Examiner, represents a complete written statement as to the substance of the interview, in accordance with M.P.E.P. § 713.04.

Claim 1

Claim 1 is directed to a method for producing a white LED of predetermined color temperature. The method includes, in a plurality of LEDs that includes uncoated blue LEDs or uncoated UV LEDs, or both, the uncoated blue LEDs or uncoated UV LEDs each having a respective wavelength, the wavelengths of the uncoated blue LEDs or uncoated UV LEDs not all being equal, measuring a wavelength of each respective uncoated blue LED or uncoated UV LED of the plurality of LEDs. The method also includes determining a single time a respective quantity of a conversion layer to be applied over each respective uncoated blue LED or uncoated UV LED of the plurality of LEDs based on at least the measured wavelength of each respective uncoated blue LED or uncoated UV LED of the plurality of LEDs. The conversion layer includes a color conversion agent, and the conversion layer is configured to absorb at least one of blue light and UV light, and emit light of longer wavelength. The method includes determining a single time a respective concentration of the conversion layer to be applied over each respective uncoated blue LED or uncoated UV LED of the plurality of LEDs based on at least the measured wavelength of each respective uncoated blue LED or uncoated UV LED of the plurality of LEDs. The conversion layer includes a color conversion agent and the conversion layer is configured to absorb at least one of blue light and UV light, and emit light of longer wavelength. The method further includes coating each respective uncoated

blue or UV LED individually, with the conversion layer having the respective quantity and concentration determined that single time in the step of determining the quantity and concentration. The coated LED has the predetermined color temperature, and the quantity and concentration of the conversion layer to be applied over each uncoated blue LED or uncoated UV LED are measured such that a constant dispensing volume of the applied conversion layer is present on each of the plurality of LEDs.

One feature of amended Claim 1 is that the quantity and concentration of the conversion layer to be applied over each uncoated blue LED or uncoated UV LED are measured such that a constant dispensing volume of the applied conversion layer is present on each of the plurality of LEDs.

Huang relates to a method of fabricating LED's. As understood from Huang, different doses of phosphor are formed on corresponding UV/blue light-emitting diodes on a wafer. The Office Action concedes that Huang is silent on teaching or suggesting a determination of a concentration of a conversion layer. Applicant submits that Huang is also silent on teaching the application of a constant dispensing volume of a conversion layer to each LED. For example, as shown in Fig. 4 of Huang, the thickness of each layer 32a, 32b, and 32c are different as a result of a different quantity of phosphor being applied for each LED. Accordingly, Huang is not seen to teach or suggest that the quantity and concentration of the conversion layer to be applied over each uncoated blue LED or uncoated UV LED are measured such that a constant dispensing volume of the applied conversion layer is present on each of the plurality of LEDs.

Mueller is not seen by Applicant as remedying the above-noted deficiency of Huang as a reference against Claim 1. Mueller is seen to disclose an LED which is disposed in a reflective cup which contains transparent material in which are dispersed

phosphor particles. See Mueller, column 5, lines 22 to 27. The phosphor particles are typically dispersed in material at a concentration of about 5% to about 35% by weight. See Mueller, column 5, lines 58 to 62. The concentration of phosphor particles is determined experimentally by measuring the emission spectrum corresponding to a trial concentration of phosphor particles, and then the concentration is adjusted as necessary. See Mueller, column 6, lines 19 to 26. The composition and concentration of phosphor particles may be varied iteratively until the desired chromaticity is achieved. See Mueller, column 7, lines 3 to 5.

Thus, Mueller is seen to disclose measuring an emission spectrum corresponding to a trial concentration of phosphor particles, and then iteratively varying the composition and concentration of phosphor particles until the desired chromaticity is achieved. In contrast to Claim 1, Mueller measures the emission spectrum of an already coated LED, but does not teach anything about measuring the wavelength of an uncoated LED or a determination of both a quantity and a concentration of a conversion layer based on at least the measured wavelength of each respective uncoated blue LED or uncoated UV LED of the plurality of LEDs. Moreover, Mueller is not seen to teach or suggest that the quantity and concentration of the conversion layer to be applied over each uncoated blue LED or uncoated UV LED are measured such that a constant dispensing volume of the applied conversion layer is present on each of the plurality of LEDs.

Accordingly, Mueller is believed to be silent on the feature of the quantity and concentration of the conversion layer to be applied over each uncoated blue LED or uncoated UV LED are measured such that a constant dispensing volume of the applied conversion layer is present on each of the plurality of LEDs.

Thus, Claim 1 and the claims dependent therefrom are believed to be allowable over Huang in view of Mueller. Because each dependent claim also is deemed to define an additional aspect of the invention, individual reconsideration of the patentability of each claim on its own merits is respectfully requested.

Claim 7

Claim 7 is directed to a white LED light source. The light source includes a plurality of blue LEDs or UV LEDs, and, above each of said LEDs, only one conversion layer. The conversion layer has a thickness, above a particular one of the blue or UV LEDs, which is proportional to a measured wavelength of that particular blue or UV LED, where the thickness of the conversion layer is constructed to be larger for a respective longer measured wavelength and is constructed to be thinner for a respective shorter measured wavelength.

Two features of Claim 7 are that there is only one conversion layer above each of the LEDs, and that each conversion layer has a thickness, above a particular one of the blue or UV LEDs, which is proportional to a measured wavelength of that particular blue or UV LED. By way of example, and not limitation, paragraph [030] of Applicant's specification states in part, "In accordance with the determined wavelength of the individual LED dice 2a, 2b, 2c, 2d the drop quantity is increased for long wavelength LED dice 2b, 2c, while it is reduced for short wavelength LED dice 2d."

Mueller-Mach is not seen by Applicant to teach or suggest that there is only one conversion layer above each of the LEDs, and that each conversion layer has a thickness, above a particular one of the blue or UV LEDs, which is proportional to a measured wavelength of that particular blue or UV LED.

As understood from Figs. 3 and 4 of Mueller-Mach three different phosphor layers 25, 26, and 27 are adjacent to a single LED. Therefore, Mueller-Mach does not teach the claimed feature of only one conversion layer. As understood by Applicant from paragraph [0038], in contrast to Claim 7, the thickness and composition of each of the respective phosphor layers 25, 26, and 27 appear to be rather arbitrarily chosen. Thus, Mueller-Mach is not seen to teach or suggest the two above-noted features of Claim 7.

Moreover, Mueller-Mach appears to teach away from the arrangement of Claim 7. For example, paragraphs [0006] and [0007] of Mueller-Mach state:

[0006] One disadvantage of using phosphor-converting epoxy in this manner is that uniformity in the white light emitted by the LED device is difficult, if not impossible, to obtain. This non-uniformity is caused by non-uniformity in the sizes of the phosphor particles mixed into the epoxy slurry. Currently, phosphor powders having uniform phosphor particle sizes generally are not available. When the phosphor powder is mixed into the epoxy slurry, the larger phosphor particles sink faster than the smaller phosphor particles. This non-uniformity in spatial distribution of the phosphor particles exists in the epoxy once it has been cured.

[0007] Therefore, obtaining a uniform distribution of the phosphor particles within the epoxy is very difficult, if not impossible, due to the non-uniformity of the sizes of the phosphor particles. This inability to control the sizes of the phosphor particles and their locations within the epoxy results in difficulties in controlling the fraction of the primary light that is summed with the phosphor-emitted yellowish light to produce white light. (Emphasis added).

Thus, Mueller-Mach acknowledges that it was difficult, if not impossible, to obtain a uniform distribution of phosphor particles in a single phosphor-converting epoxy layer and to control the fraction of the primary light that is summed with the phosphor-emitted yellowish light to produce white light. Thus, Mueller-Mach is believed to teach away from the claimed feature of a light source having above each LED only one conversion layer.

Huang does not remedy the deficiencies of Mueller-Mach noted above against independent Claim 7. Contrary to the claimed features of Claim 7, Huang apparently teaches that as the wavelength of the light emitted from the diode increases, the quantity of the dose of phosphor applied to the LED is decreased. For example, col. 3, lines 40 to 65 of Huang is repeated below:

Next, as shown in FIG. 2, the step 300 describes that the different doses of phosphor are formed on the corresponding UV/blue light-emitting diodes on the wafer according to the respective spectrums. In the embodiment, according to respective spectrums, the different doses of phosphor are formed on the corresponding light-emitting diodes by using ink jet printing. For example, when the light-emitting diode shown on the right of FIG. 4 emits a first wavelength 450 nm, i.e. standard wavelength, a standard dose of phosphor 32a is formed thereon by ink jet printing. Therefore, the color temperature of the modulated light from the diode is 6000 K. When the light-emitting diode shown in the middle of FIG. 4 emits a first wavelength 455 nm, a smaller dose of phosphor 32b is formed thereon by ink jet printing. Thus, this diode also emits white light with the same color temperature. When the light-emitting diode shown on the left of FIG. 4 emits a first wavelength 445 nm, a larger dose of phosphor 32c is formed thereon by ink jet printing. Therefore, the diode also emits white light with the same color temperature. When the first wavelength emitted from the diode is longer than the standard wavelength, the total area of the second wavelength radiated from the phosphor material is reduced so as to modulate white light with color temperature of 6000 K according to the color matching function. In other words, the dose of phosphor forming on the light-emitting diode on the wafer is reduced. (Emphasis added).

Thus, contrary to Claim 7, Huang is seen to disclose that the dose of phosphor forming on the LED is reduced when the wavelength emitted from the LED is longer than a standard wavelength, and the dose is increased when the emitted wavelength is shorter than the standard wavelength. See Huang, column 3, line 59, to column 4, line 5. Thus, Huang is seen to disclose an inverse proportionality between the dose and the wavelength.

Accordingly, Huang is not seen to teach or suggest that the conversion layer has a thickness, above a particular one of the blue or UV LEDs, which is proportional to a measured wavelength of that particular blue or UV LED, where the thickness of the conversion layer is constructed to be larger for a respective longer measured wavelength and is constructed to be thinner for a respective shorter measured wavelength.

Also, Applicant submits that the proposed modifications of Mueller-Mach with Huang would change the principle of operation of Mueller-Mach. See MPEP § 2143.01 VI. In considering whether the principle of operation of the prior art invention is changed, courts have considered whether the suggested combination of references would require a substantial reconstruction and redesign of the elements shown in the primary reference as well as a change in the basic principle under which the primary reference construction was designed to operate. See MPEP § 2143.01 VI.

As discussed above, Mueller-Mach suggests a multilayered phosphor structure having layers 25, 26, and 27 adjacent to an LED. Each of the layers 25, 26, and 27 is separated, apparently, to convert a portion of primary light. Thus, the basic principle of operation of the Mueller-Mach structure is believed to be that primary light is converted by a series of discrete phosphor layers having different compositions and thicknesses. To achieve the claimed “only one conversion layer” in Claim 7 would likely require a substantial reconstruction of the multi-layer structure shown in Figs. 3 and 4 of Mueller-Mach and would change the principle of operation of the Mueller-Mach structure.

Thus, Claim 7 is believed to be allowable over Mueller-Mach and Huang, whether considered separately or in any permissible combination, if any.

New Claim 10 is directed to a method for producing a white LED of predetermined color temperature, comprising, *inter alia*, coating each respective uncoated

blue or UV LED individually, with the conversion layer having the respective quantity and concentration determined that single time in said step of determining the quantity and concentration, where the coated LED has the predetermined color temperature, and where the conversion layer has a thickness, above a particular one of the blue or UV LEDs, that is proportional to a determined wavelength of that particular blue or UV LED, and where the thickness of the conversion layer is increased for a respective longer wavelength and decreased for a respective shorter wavelength.

Thus one feature of Claim 10 is that each LED is coated where the conversion layer has a thickness, above a particular one of the blue or UV LEDs, that is proportional to a measured wavelength of that particular blue or UV LED, and where the thickness of the conversion layer is increased for a respective longer wavelength measured and decreased for a respective shorter wavelength measured.

The previously cited art is not believed to teach or suggest the features of Claim 10. Accordingly, Claim 10 is also believed to be allowable over previously cited art.

No other matters being raised, it is believed that the entire application is fully in condition for allowance, and such action is courteously solicited.

Applicant's undersigned attorney may be reached in our Costa Mesa, California office by telephone at (714) 540-8700. All correspondence should continue to be directed to our below listed address.

Respectfully submitted,

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